

**BUILDING AIR QUALITY**  
**A GUIDE FOR BUILDING OWNERS,**  
**FACILITY MANAGERS AND**  
**AGENCY CONTACTS**



*Admin*  
**MINNESOTA**

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# CONTENTS

INTRODUCTION	3
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## DESIGN PARAMETERS

1.	Purpose	4
2.	Scope	4
3.	Consultant Duties	4
4.	Ventilation Codes and Standards	4
5.	Mechanical Design Requirements	5
6.	Schematic Design	9
7.	Design Development	12
8.	Working Drawings	13
9.	Construction Work	14

## **INTRODUCTION**

State agencies are in custodial control of thousands of state-owned buildings, and lease thousands more throughout the State of Minnesota. A number of those buildings have had complaints about the quality of the indoor air. That number has steadily increased over the last few years. The Department of Administration formed the Indoor Air Quality Task Force with the charge of developing guidelines to prevent the development of additional air quality problems, and to assist in mitigating existing problems. The completed guidelines are intended for use by Architects and Engineers who design new and remodeled structures for state use..

The Task Force involves eight state agencies whose members include department managers, mechanical engineers, industrial hygienists, an indoor air quality specialist, safety administrators, a building code expert, and a facility manager.

The Design Parameters section sets forth mechanical requirements for the construction of new buildings and for major renovation or remodeling of existing buildings. The Operations/Maintenance section has the minimum operating requirements for janitorial services, pest management, mechanical system maintenance, temperature and humidity control, and hazardous materials.

## **DESIGN PARAMETERS**

### **1. Purpose**

To specify minimum acceptable building design guidelines which will provide acceptable air quality for building occupants.

### **2. Scope**

These guidelines apply to all new and remodeled state-owned and leased buildings.

### **3. Consultant Duties**

It is the responsibility of the design team to design mechanical, electrical, and architectural building features to achieve proper air quality. These duties include the following:

- A. Design building ventilation systems to meet applicable codes.
- B. Provide adequate space for installation, removal, repair, and maintenance of mechanical equipment.
- C. Provide adequate space to allow proper operational installation of equipment.
- D. Interview agency personnel to determine operational program needs of each space.
- E. Obtain material safety data sheets from vendor and consult qualified references, such as the American Conference of Governmental Industrial Hygienists (ACGIH) Ventilation Manual for special use spaces such as printing and photographic areas, in order to determine proper ventilation requirements.
- F. Provide adequately detailed drawings and specifications to allow proper installation of equipment.

Most building problems are identified because of comfort complaints by occupants. Many of these problems are the result of inadequate design. Design consultants need to follow recognized design standards found in building codes, manufacturer's recommended installation procedures, the ASHRAE Guide or other recognized standard.

### **4. Ventilation Codes and Standards**

The following codes and standards are referenced for designers to follow on both new construction and renovation or remodeling projects.

If any of the standards are modified after the date of this set of guidelines, the latest version will apply.

- A. ASHRAE Standard 62-1989 published by the American Society of Heating Refrigeration and Air Conditioning Engineers and as amended by the State Building Code Division.

- B. OSHA Standard 29 CFR 1910 Subpart Z - Toxic and Hazardous Substances - Title 29 Code of Federal Regulations General Industry Standards enforced by the Minnesota Department of Labor and Industry Occupational Safety and Health Administration.
- C. Minnesota Department of Health Rules for Health Care Facilities including, Hospitals, Nursing Homes, Boarding Homes, and Supervised Living Facilities.
- D. Industrial Ventilation, A Manual of Recommended Practice published by the American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation, 6500 Glenway Avenue, Cincinnati, Ohio 45211.
- E. The Uniform Building Code, Uniform Mechanical Code, Uniform Fire Code, and other related documents adopted and amended by the State Building Codes and Standards Division.
- F. ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices Published by the American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Cincinnati, Ohio 45211

## **5. Mechanical Design Requirements**

### **A. OUTSIDE/VENTILATION AIR REQUIREMENTS**

In order to maintain building air quality, the consultant must furnish the following design information in construction documents as a permanent record of outdoor design requirements.

1. The minimum outside air quantity and number of building occupants that are intended to be served must be specified for each supply fan connected to an outdoor air louver.
2. The designer must specify the source(s) of outside air for each exhaust fan provided in the building. Heated and cooled outside air must be provided for each exhaust fan system. Building air infiltration must not be used as an air source for an exhaust fan.
3. Building outdoor air intakes must be accessible for measuring outside air quantities. As an option, the design may provide an adequate length of straight duct inside a building that permits accurate measurement of outside air flow.
4. The consultant must design and detail automatic controls to provide minimum outdoor air quantities for each supply fan system. These controls must be diagrammed on construction documents. On building systems with Variable Air Volume (VAV) design, automatic controls must be provided to vary the minimum outdoor damper position as fan system air flow varies from minimum to maximum. A certified balancing and testing company whose sole business is testing and balancing must measure outside air quantities of such systems at both full cooling and full heating to verify proper outdoor air flow quantities.

5. On supply fan systems that intermittently provide outside air to fume hoods, range hoods, or other exhaust systems, automatic controls must be provided to increase the supply of outside air to meet these exhaust needs. Such controls must be diagrammed on construction documents. A balancing and testing company must measure and adjust controls to provide proper outside air to meet such needs.
6. The water source for buildings using humidification systems shall be potable water. Steam humidification is the preferred method of humidification. The following chemicals shall not be used in direct-steam humidification systems: cyclohexylamine, diethylaminoethanol and morpholine. Clean steam using a source of deionized water is recommended. Use of boiler treatment chemicals is not recommended.

## B. DESIGN DIVERSITY FACTORS

Diversity factors must not be used for selecting capacity of boilers, air conditioners, heating pumps, cooling pumps, fans and other mechanical equipment. An additional 30 percent safety factor must be added to the net load used for selecting heating and or cooling equipment capacity to allow for pickup loads and assure adequate capacity. The minimum design capacity for heating and cooling must be based on the following parameters:

1. Capacity for summation of all exhaust fans.
2. Capacity for the summation of all outside ventilation sources to meet occupant load.
3. One infiltration air change for heating, and one half air change cooling per hour.
4. Summation of solar heat gain for all window glazing based on the assumption that blinds and draperies are not used (cooling).
5. Cooling allowance for summation of all lighting fixtures.
6. Cooling allowance for summation of all electrical appliances including office machines. Consultants are responsible for interviewing building staff members to assess appliance loads. Normally, these will vary from 0.5 - 3.0 watts per square foot of floor area. Consultants must provide a list of appliances as well as make judgment allowance for appliances when building staff are unable to provide detailed descriptions of anticipated equipment. Consultants must provide a complete copy of all calculations performed for sizing building equipment as a permanent record of design requirements. Computer analyzed systems must provide a list of each computer algorithm used to derive tabulated data. This data must also include design parameters used as a basis for performing calculations.

## C. HVAC SYSTEMS DESIGN CRITERIA

Air conditioning is considered standard for all buildings except industrial spaces or structures with temporary occupancy. Experience with state buildings has shown that central air handling systems provide numerous benefits as a design choice. The utilization of variable air volume terminal units is the preferred design for buildings larger than 15,000 gross square feet (GSF). The use of multizone, dual duct, or heat pump type systems, or any space not cooled require the review and written approval of the state agency or it's authorized representative of record.

The following criteria provides a design basis for mechanical systems to achieve the goal of acceptable air quality.

1. Mechanical equipment must be centrally located in equipment rooms and penthouses with conventional stairs and elevators provided. The use of rooftop mounted heating and cooling equipment requires review and written approval from the state. In the case where rooftop units are approved, it is the responsibility of the designer to make sure the equipment complies with Minnesota code requirements. The designer must verify a proper size for air intake and exhaust louvers that do not exceed 500 FPM intake, and 1000 FPM exhaust. Intake and relief openings must have proper distance separation as required by code. Percentage of outside air must not exceed manufacturer's limitations on gas fired heat exchangers. When gas fired equipment is used for makeup air systems, a "direct fired" style with modulating controls is required. Hot water, steam, or modulating electric heating must be used for applications where the code prohibits "direct fired" equipment.
2. All building spaces, interior and exterior, must have zoned controlled heating. A booster heating coil is recommended for all terminal units serving either exterior or interior building zones. Interior zones must have a heat source to allow minimum ventilation requirements.
3. Reheat systems must be provided for air conditioned spaces when needed to control comfort due to code required constant ventilation. These areas can include laboratory spaces with exhaust hoods and various spaces in health care facilities. Typical examples would include a barber shop or bathing room in a nursing home. Both spaces require a constant ten air changes per hour of supply and exhaust. In both instances, over-cooling will occur without some form of reheat. Consultants must identify these spaces and the methods used to control comfort. Room air diffusers, in rooms with ceiling heights of less than 10 feet, will not discharge air at a temperature colder than 58 degrees.
4. Chilled water air conditioning must be used with Variable Air Volume and Make-up Air Systems. Direct Expansion (DX) can be used on small single zone fan systems when chilled water cooling is not economically practical. Cooling coils must be selected to allow discharge air temperatures as low as 50° F. at design conditions to provide proper humidity control. Design relative humidity levels in the occupied space during the cooling season are not to exceed 50 percent.

Relative humidity in excess of 50 percent can potentially cause microbial concerns (growth of dust mites, fungi including molds, bacteria) with building materials or office furnishings in the occupied space.

5. Fan and duct systems must not be lined with internal thermal insulation. Insulation must be applied to exterior of duct and fan surfaces. Fan sections may employ internal perforated plates covering coated duct insulation as needed for sound control. The floor surface directly below the fan must be continuous metal with a liquid tight seal to prevent condensate from contact with duct insulation.

Fan systems must be designed to allow the mixed air to be filtered. The collection efficiency of the filters must be a minimum of 30 percent efficiency as certified by the manufacturer using the ASHRAE Standard 52-92 Atmospheric Dust Spot Efficiency Test. Filter holders must allow the use of a minimum of 2 or 4 inch thick filters. One inch thick filters are not acceptable.

6. Return fans must be used on fan systems with a capacity greater than 6,000 CFM that utilize economizer controls. Return fans are not required on make-up air systems.
7. Unions or flanges must be provided on coil and equipment piping connections to facilitate removal of same for cleaning or replacement.
8. Flow sensors must be provided for hydronic and chilled water systems. Flow sensors must be provided for all coils, radiation elements, pumps, and secondary piping loops. Flow sensors must be installed in accessible locations and strictly according to manufacturer's recommendations. Consultants must provide size of flow sensors for each device. Gauges with shut-off valves must be provided for suction and discharge of all pumps. The supply and return water must be provided with thermometers with thermal wells for all heating and cooling coils in central fan systems, hot water boilers, chillers, and convertors.
9. Air foil or backward inclined fan wheels must be used on fan systems requiring more than 2.0" water column (w.c.) of total fan static pressure or 1 inch w.c. of external static pressure.
10. Central air handling equipment must be provided with a heating coil to be used for morning warm-up cycle. Coils must be capable of providing up to 90° F. discharge temperature during building warm-up cycle.
11. Multiple boilers must be provided with standby capacity in event of a boiler failure.
12. Thermostat zone control must be provided to prevent wide temperature fluctuations. Buildings must be zoned such that exterior and interior spaces have separate control. Thermostat zones must avoid controlling spaces with multiple exterior exposures. Radiation and ventilation systems must be zoned to prevent simultaneous heating and cooling. Thermostats must cycle the heating valves closed prior to increasing air flow from VAV boxes. VAV boxes are to be designed to have adjustable minimum air settings and are not to be designed to



close completely in all cases. Under most situations, VAV boxes will provide at least 20 percent air flow at minimum settings. Private offices and areas with small room partitions must have zone areas limited to 1,000 GSF. Open office areas can be zoned up to 2,000 GSF. Gymnasiums, swimming pools, and other industrial spaces can have a recommended zone area of 5,000 GSF. Health care facilities are recommended with zone control for each room. Administration areas in health care facilities may be zoned as conventional office spaces.

13. The basis of control design with central air handling systems is pneumatic controls with time clocks for unoccupied periods.

Computer based electronic or DDC controls require review and written approval of the state. Control cabinets are preferred for mounting of controls for central station air handling equipment. The following control features are required for each fan system:

Temperature indication and adjustment for mixed air

Temperature indication and adjustment for discharge air heating and cooling

Summer/winter position switch

Adjustment and set point for static pressure control of fans on VAV systems

Adjustment of outdoor air minimum position for ventilation

14. Freeze protection must be provided to protect systems with hot water or steam coils. These methods include face and bypass dampers, "wing type" coils, constant flow circulating pumps, and antifreeze solutions. Attention must be given to provide proper mixing of outside and return air streams to avoid stratification. It is preferred to avoid the use of antifreeze solutions.
15. Access panels must be provided to service valves, VAV terminal units, and other mechanical equipment located inside walls, chases, or above inaccessible ceilings.

## **6. Schematic Design**

Schematic Design is the phase where the mechanical systems are conceptually designed. Locations of outdoor air and exhaust air, must be detailed by identifying each opening, the quantity of air, and the system served. Further, locations of loading docks, vent lines, engine exhaust stacks, and other contamination sources must be clearly identified. A narrative review must be provided by the consultant to demonstrate reasonable efforts have been taken to avoid cross contamination. It is usually advantageous to keep fresh air intakes low on the roof and to direct contamination exhaust as high off the roof as possible. Weather caps which deflect exhaust air downward are not recommended because they tend to keep contaminated air relatively close to the roof surface when the goal is to direct the contaminated air upward away from the roof. Potential contamination sources must have a vertical discharge stack. Vertical discharge stacks are outlined in the ACGIH Manual "Industrial Ventilation" "Stackhead Construction".

It is important to recognize that both Schematic Design and Design Development Phases are for the purpose of defining the scope of a project and determining the adequacy of funding.

The state has the right to direct scope changes during both of these work phases without the reimbursement of additional fees to the consultant. These changes may include larger mechanical electrical rooms, revised mechanical systems and architecture as needed to accomplish the goals of indoor air quality. Drawings must detail the following information:

- A. The consultant must provide data on outdoor air louvers and gravity relief hoods to demonstrate reasonable protection against snow and rain penetration. These must include catalog data. Further, calculations must be provided to verify air pressure drops and velocities are not excessive.
- B. Equipment rooms must be sized and detailed for mechanical, electrical, elevator, telephone, and maintenance functions. Detailed plans must be provided for each equipment room showing equipment sizes and capacities.
- C. A detailed list must be provided of mechanical equipment needed for environmental control. Manufacturer's recommended access for servicing must also be noted.
- D. Cooling towers and condensing units must be located to prevent contamination of outdoor air intakes.

Small confined contamination sources - such as sanitary vents. The fresh air intake must be installed no closer than 20 feet from such openings. This distance can be a combination of vertical and horizontal distances. For example, if the vent exhausts at an elevation 10 feet higher than the fresh air intakes, then the horizontal distance can be reduced to 10 feet.

Large confined contamination sources - such as clothes dryer vents, flue gas vents from combustion heaters, exhaust vents from parking garages, laboratory vent hoods and cooking exhaust vents. If the potential contamination source (i.e. cooking exhaust vent) has a vertical discharge stack extending at least 5 feet higher than the height of the fresh air intake on the roof, then the fresh air intake may be located no closer than 40 feet horizontal from the potential contamination source.

If the potential contamination source (i.e. cooking exhaust vent) does not have a vertical discharge stack extending at least 5 feet higher than the height of the fresh air intake on the roof, then the fresh air intake may be located no closer than 80 feet horizontal from the potential contamination source.

Large non-confined contamination sources - such as cooling towers, parking areas, and loading docks (loading dock area boundaries include the area where vehicles park while loading and unloading). The fresh air intake must be located no closer than 100 feet to the potential contamination source.

This distance may be a combination of horizontal and vertical distances **but the horizontal distance may never be less than 40 feet.**

- E. Architectural drawings must identify available ceiling space in all building areas at the Schematic Design Phase of work. A review with the state and consultants must verify the space is adequate for mechanical, electrical and other utility needs. The Architect will not adjust any ceiling height after Schematic Design without written approval from the state.
- F. On buildings larger than 20,000 GSF, 30 inches of vertical ceiling space must be designed for mechanical and electrical equipment including duct work, piping, lighting. Architectural drawings must identify all locations where structural elements or raised ceiling elements reduce the ceiling space to less than 24 inches. Areas with reduced ceiling height will not be allowed where they create hardship for design or maintenance of mechanical and electrical systems.
- G. On remodeled buildings with less available ceiling space, the Architectural drawings must detail soffits to facilitate installation of duct work, piping, and light fixtures. These must be shown on schematic design documents.
- H. Adequate space in equipment rooms is essential to proper design. Added ceiling height must be provided in mechanical equipment rooms with air moving equipment. Ceiling height must be a minimum of 12'-6" in mechanical rooms with fan systems totaling up to 10,000 CFM. Ceiling height must be increased to 14'-0" with fan systems totaling between 10,000 - 20,000 CFM. Ceiling space must be 16'-0" minimum in fan rooms with system capacities totaling more than 20,000 CFM. Immediate notification must be provided to the state when these parameters are not achievable. Variations from this datum require written approval of the state.
- I. Access for servicing and replacement of equipment must be detailed and described on Schematic Design Documents. Easy access must be provided for servicing filters, coils, strainers, control dampers, control valves, fans, motors, pumps, boilers, chillers. Knockout panels, double mechanical room doors, increased corridor width must be noted on drawings when needed for access or replacement equipment.

Ductwork and other parts of the air handling system need to be inspected on a regular basis. Ductwork and other parts of the air handling system need to have easy-to-open observation and clean out doors. These doors shall be operable without the use of tools and must be air tight with locking seals and must not interfere with air flow inside the air handling unit. These doors must be installed at a minimum in the following locations:

1. Clean out door(s) (as large as possible) upstream and downstream of cooling coils to allow maintenance workers good access to clean the ductwork within five feet up and downstream of the cooling coils, the cooling coils and drainage pans from the cooling coils.
2. Inspection door(s) (minimum 10 inch size) 10 to 20 feet downstream of the cooling coils. If there are several supply air ductwork branches in this area, an inspection door needs to be installed in each branch.
3. Clean out door(s) (as large as possible) at the filtration system for the air handling unit to inspect the ductwork surfaces five feet on each side of the filtration system.

4. Inspection doors (minimum 10 inch size) 10 to 20 feet upstream of the filtration systems. If there are several return and/or mixed air ductwork branches in this area, an inspection door needs to be installed in each branch.
- J. Design parameters need to be identified for areas such as chemistry labs, photo labs, science labs, copy duplicating, kitchen, swimming pools, and other spaces having special mechanical/electrical needs. Consultants need to identify applicable codes and standards used as a basis of design. Consultants also need to identify limitations of design that will affect use of space. Such data may include a notice that chemistry labs cannot use concentrated acids without installing additional fume hoods. Another for non-grease vapors. Limitations on occupancy and use of spaces must be clearly defined on Schematic Design Documents.

## **7. Design Development**

Design Development commences after written approval is furnished by the state's contracting authority. During this phase, working drawings begin to develop showing equipment sizes and locations; routings of major piping and ductwork; and proposed mechanical system configurations. Design Development must incorporate review comments directed by the state during Schematic Design. All data must be provided to demonstrate the project will meet programming needs.

- A. Site plans must be provided showing proposed utility connections and routings. The consultant must identify utility needs for the project and investigate availability of needed services. The consultant must determine the need for on site wells, sewage systems, storm drains and report these needs to the state. The consultant will review with the state the various options available and their cost impact.
- B. A prime concern is review of available energy sources to provide building heating and process needs. Selection of fuel must be based on life cycle cost. Interruptible gas must be considered on projects where annual fuel costs exceed \$30,000. Connections to existing buildings or campuses may allow connection to existing piping systems. However, consultants must review capacities of existing systems to determine feasibility of extending service from existing campus and structures to serve new construction.
- C. This phase of work must include an extensive code search to establish applicable design requirements. Consultants must note and reference key code provisions that impact design.
- D. Consultants must identify all problems related to space limitations that affect design of mechanical and electrical equipment installation or service. Architects must notify the state when duct and piping configurations require alterations to allow use of skylights, raised ceilings, large glass areas, atriums, mezzanines, curved wall sections or other unusual conditions. Where design compromises are required, these must be reviewed and approved by the state.
- E. Completed calculations and design data must be provided to demonstrate Design IAQ Guidelines are being followed. The state will review Design Development Documents and offer written review comments regarding programming and design. Consultants must

incorporate review comments into working drawings of the project. The state reserves the right to direct design changes at this phase of work without additional consulting fees being incurred. These efforts may include deleting architectural finishes and prominent features to accomplish the goals of IAQ Guidelines.

- F. Accessibility of ceilings is an important design consideration. Design Development documents must identify all areas that do not utilize lay in ceilings. The type of ceiling construction must be identified for each building area along with implications for servicing equipment. Access panels must be noted indicating size and equipment to be serviced. Drawings must also note when access panels are not required.

## **8. Working Drawings**

Consultants must proceed with preparation of working drawings based on state review comments. Sufficient detail must be provided in specifications and drawings to allow construction and accomplish the goals of IAQ. Consultants must also identify procedures needed to deal with hazardous construction materials, solvents, adhesives, paint vapors, and all volatile compounds. Positive ventilation and monitoring must be provided when needed.

Careful attention is needed to avoid problems during construction alterations to existing occupied buildings. Construction documents must provide direction to the contractors on these issues.

- A. Construction and remodeling often involves abatement of hazardous waste such as asbestos. The state has separate consultant and construction contracts to deal with these issues. However, building designers are required to coordinate design and contracting efforts with the abatement process. Designers need to be cognizant of the effects construction will have on abatement. Project consultants need to carefully describe construction areas to allow proper determination of hazardous waste removal by the Abatement Consultant. Replacement of insulation and building finishes after abatement will be included as part of construction.
- B. Testing and balancing is a crucial part of providing proper indoor air quality. Building mechanical systems must not be accepted as "Substantially Complete" until testing and balancing is completed. Test and Balance reports must be reviewed and approved by both the project consultant and the state. Consultants are responsible to provide all design services required to diagnose and correct systems that do not function properly or can not be balanced to design specifications.
- C. VAV terminal units must be a pressure independent type and detailed for proper installation. Design documents must detail distances from elbows and fittings that are needed for proper air flow. The total fan air flow must equal the total air flow of all terminal units. Balancing dampers must be shown on contract documents and not left to the discretion of the contractor. Dampers in diffusers and registers must not be used for balancing air flow. Dampers for adjusting air flow must be detailed at least 5'-0" upstream from each air outlet. Volume dampers must also be shown on each branch duct line.
- D. Specifications must include the following additional air balancing requirements. Air systems must be adjusted at both full cooling and full heating air flows. The supply fan must be adjusted to the lowest horsepower setting required to achieve full air flow at the most remote air terminal. Air flow must be adjusted to within 10% of rated flow at all

outlets. Care must be taken to avoid a majority of air outlets being adjusted 10% below design. The quantity of outside air, return air and relief air must be measured at both conditions of full heating and full cooling. Each fan system must provide minimum outdoor air required for ventilation purposes at all design conditions.

- E. Hydronic and chilled water systems specifications must include the following additional requirements. Water flow must be balanced at full cooling for chilled water systems, and full heating for hydronic systems. Outlets must be balanced to within 10 percent of rated flow. Pumps and piping must be sized to provide full flow at all outlets.

Pump discharge pressure must be adjusted to the lowest setting possible to achieve balance at the hydraulically most remote terminal. The balancing contractor must note the system pressure required for balance. This will afford the state the opportunity to shave the pump impeller to reduce building energy costs.

- F. Testing must also be specified for boiler combustion on all forced draft style burners and all fuels. Tests must be provided from low to high fire. On modulating burners combustion tests must be performed at a minimum of four firing rates. Test data must include, Oxygen, Oxides of Nitrogen, Sulfur Dioxide, Carbon Monoxide, Carbon Dioxide, Stack Temperature, and boiler efficiency. Test meters with test cells specifically for measuring Carbon Dioxide must be utilized.
- G. Consideration must be given for design to control sound levels. General design requirements must be for a 35 NC sound level in occupied spaces.
- H. Consultants must identify work requirements and site limitations for each project. Facilities such as Corrections or Health Care often require special provisions including security procedures, parking, and access of materials and storage. These must be carefully detailed on bid documents.
- I. Consultants must obtain written approval and review of bidding documents from appropriate code agencies. These efforts must also include obtaining environmental permits for air, water quality and others as required to proceed with the project.
- J. Consultants must coordinate design with utility companies for connections, of water, sewer, gas, electric, and telecommunications. Specifications must require contractors to pay for sewer access charge (SAC), water access charge (WAC), and all other required connection charges.

## **9. Construction Work**

Consultants must make periodic visits to the site; make note of observed deficiencies; provide written responses to contractors in a timely manner regarding errors and conflicts between bidding documents and field conditions; must prepare and issue revised drawings to contractors to resolve installation conflicts. Contractor's questions must be answered in writing. All revisions must be incorporated into "As Built" drawings by consultant. Consultants must not pass this responsibility to contractors.

- A. Consultants must attend construction meetings when their input is needed to resolve disputes and conflicts with contractors. In addition, consultants must be available to meet

at the work site when their expertise is needed to resolve installation problems. Consultants may be held liable for delay claims caused by inaction to resolve disputes and conflicts.

- B. Consultants must carefully review shop drawings and note errors and deficiencies. Consultants do not have the authority to allow deviations from bidding documents without written approval of the state. Consultants cannot approve substitute materials that do not meet requirements of the bidding documents. The state must be notified when contractors make claims the specifications cannot be accomplished or when specified equipment is not available. Consultants must maintain Shop Drawing records for a period of five years. Shop Drawings must be returned to contractors for inclusion in maintenance manuals delivered to the state at the conclusion of the project. Consultant's copy of shop drawings must be available to the state upon written request.
- C. Consultants must provide professional services as needed to resolve warranty issues during the warranty period. Fees for such service must be recovered from the contractor under the terms of the AIA General Supplementary General Conditions.